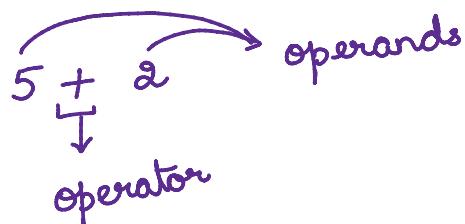


Operators

- Arithmetic Operators
 - Increment / Decrement
 - Relational
 - Logical Operators
 - Bitwise Operators

All numbers
+ , -
except 0
↓
True
 $0 \rightarrow \text{false}$

operators : symbols perform operations



Arithmetic Operators:

(2 operands)
"Binary operators"

+ - * / %

$5 + 2 = 7$ int + int → int

$$7 - 1 = 6 \quad \text{double} \rightarrow \text{double}$$

$$4 * 3 = 12$$

$$9/2 = 4$$

$$9 \% 2 = 1$$

double → float → long → int

`double + float = double`

float + long = float

$$a = 5.0 \quad b = 2$$

$$3.2 + 1 = 4.2$$

$$5.0 \cancel{+} \quad a + b = C \rightarrow \text{double}$$

$$\rightarrow \text{int}$$

b = 2 cout

$$9/2$$

$$= 4$$

$$9/2 \rightarrow 4$$

int / int int
int int

$$4.5$$

int a = 9;
 int b = 2;
 double c = a/b;

double c = 4; (Type casting)

double a = 9;
int b = 2;
double c = 9/2 = 4.5

int a = 9;
int b = 2;
double c = (double)a/b;

$$4.5$$

$$a/(double)b;$$

$$\begin{array}{r} 4 + 2 * 5 \\ \quad \quad \quad \boxed{2 * 5} \\ 4 + 10 \\ 14 \end{array}$$

Precedence:

* / %
+ -

$$5 * 2 / 4$$

$$10/4$$

Associativity
Left to Right

Brackets: highest precedence

$$5 * (4/2)$$

$$5 * 2 / 4 =$$

$$10 / 4 \longrightarrow 2$$

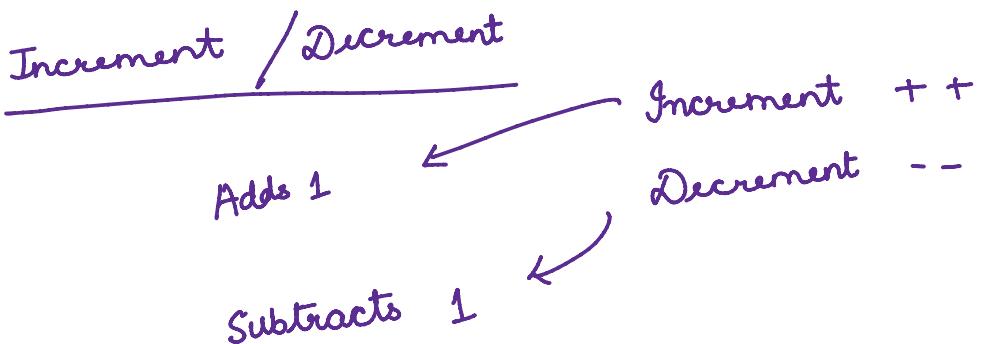
$$5 * 2.0 / 4$$

$$5 * (2 / 4) =$$

$$5 * 0 \longrightarrow 0$$

$$10.0 / 4$$

$$2.5$$



```

int a = 5;
a++; // a = a + 1
cout << a; a=6
  
```

```

int a = 3;
a--; // a = a - 1
cout << a; a=2
  
```

```

int a = 7;
++ a; // a = a + 1
cout << a; a=8
  
```

```

int a = 9;
--a; // a = a - 1
cout << a;   a = 8

```

1 operand
(Unary operators)

$++\text{var}$ $--\text{var}$ <div style="border-bottom: 1px solid black; width: 100%;"></div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> Pre increment or Pre decrement </div> <div style="width: 45%;"> Post increment or Post decrement </div> </div>	or $\text{var}++$ or $\text{var}--$ <div style="border-bottom: 1px solid black; width: 100%;"></div>
--	--

```

int a = 4;
int b = ++a;      2 Tasks
                    ① Incrementing
                    ② Assigning
                    Pre increment

a = a + 1          a = 5
b = a              b = 5

```

"5, 5"

```

int a = 4;
int b = a++;       2 Tasks
                    2) Increment
                    1) Assigning
                    a = a + 1    b = 4

b = a
a = a + 1          a = 5

```

"5, 4"

↙ int x = 7;
| ↘ int x = 7;
| x = x --;

Q int $x = 7;$
 int $y = --x;$
 $x, y = ?$

① $x = x - 1$ 6
 ② $y = x$ 6
 $6, 6$

↙ int $x = 7;$
 int $y = x --;$
 $x, y = ?$

① $y = x$ $y = 7$
 ② $x = x - 1$ $x = 6.$
 $6, 7$

int $a = 5;$
cout << $a++$;

1.) cout << a
 2.) $a = a + 1$

2 Tasks
 Printing, Incrementing
 ① ②
Print 5.
 $\underline{a = 6}$

int $a = 5;$
cout << ++a;

1.) $a = a + 1$ $a = 6$
 2.) cout << a Print 6

2 Tasks
 Printing, Incrementing
 ② ①

```
int x = 7;  
cout << x--;
```

7

```
int x = 7;  
cout << --x;
```

6

```
int a=10;  
int b=-a;  
int c=b+2;  
int d=c-2;  
cout << a << " << ++b << " << c++ << " << d;
```

```
int a = 10;
```

```
int b = --a;
```

$$\begin{array}{l} \rightarrow a = a - 1 \\ \rightarrow b = a \end{array}$$

a = 9
b = 9

```
int c = b++;
```

$$\begin{array}{l} \rightarrow c = b \\ \rightarrow b = b + 1 \end{array}$$

c = 9
b = 10

```
int d = c--;
```

$$\begin{array}{l} \rightarrow d = c \\ \rightarrow c = c - 1 \end{array}$$

d = 9
c = 8

```
cout << a << " << ++b << " << c++ << " << d;
```

$$\begin{array}{ccccccc} \downarrow & & & & & & \downarrow \\ 9 & & & & 8 & & 9 \\ & \overline{b = b + 1} & & & & & \\ & b = 11 & & & & & \\ & \downarrow & & & & & \\ & 11 & & & \overline{\text{"c = 9"}} & & \end{array}$$

Relational Operators

Used for comparison

Used for comparison

'2 operands' → Binary operators

Boolean output

1. $>$ (greater than)

$a > b$

$5 > 2$	→ true
$3 > 6$	→ false
$4 > 4$	→ false

2. $<$ (less than)

$a < b$

$2 < 5$	→ true
$8 < 4$	→ false
$6 < 6$	→ false

3. \geq (greater than or equal to)

4. $a >= b$

$8 >= 5$	true
$7 >= 7$	true
$6 >= 9$	false

4. \leq (less than or equal to)

$a \leq b$

$5 \leq 9$	true
$6 \leq 6$	true
$9 \leq 4$	false

5. $==$ (equal to)

$a = 4$ assigning

$5 == 5$	true
$8 == 3$	false

$a = 8;$

$a == 3 \rightarrow \text{false}$

6. $!=$ (not equal to)

$7 != 2$	true
$6 != 6$	false

Logical Operators.

Logical Operators.

Input : Boolean

Output : Boolean

AND
 $\&\&$

OR
 $||$

NOT
 $!$

2 operands
Binary Operator

1 operand
Unary Operator

AND

I/p 1

I/p 2

O/P .

$0 \rightarrow \text{false}$
 $1 \rightarrow \text{true}$

0

0

0

(and = *)

0

1

0

1

0

0

1

1

1

$(5 >= 2)$

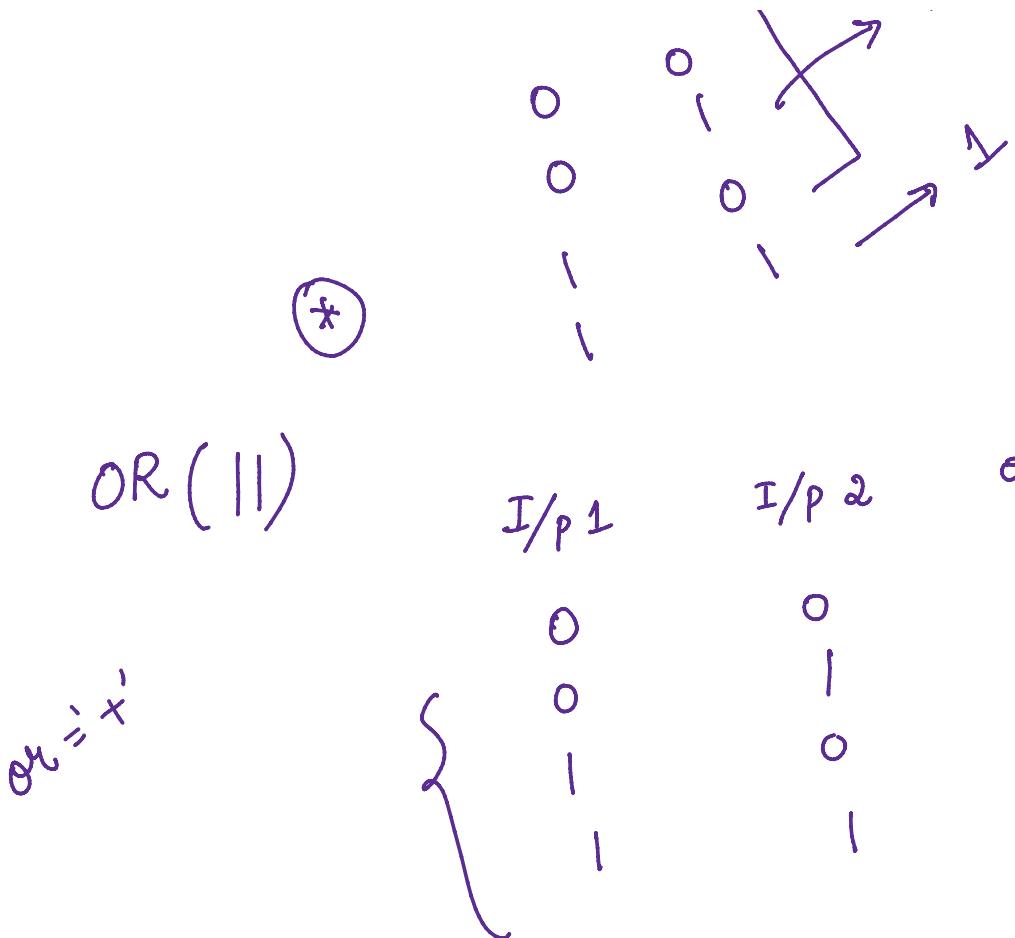
true

$\&\&$
Logical

$(2 != 5)$
true

$\rightarrow \text{true}$

$0 \cdot 1 \neq 0$
 $\cancel{0 \cdot 1} \rightarrow O/P = 0$



$(8 \geq 5) \And (2 \geq 6) \Rightarrow \text{true} \And \text{false} = \text{false}$

$(8 \geq 5) \quad \text{||} \quad (2 \geq 6) \Rightarrow \text{true} \quad \text{||} \quad \text{false} = \text{true}$

! (NOT)
-negates'

I/p	O/P
0	1
1	0

$! (8 \leq 9) = \text{false}$
 $! \text{true}$

$a = 5;$
 $b = 6;$

! true

$!(7 > 8) \rightarrow \text{true}$

$!(a != b) \rightarrow \text{true}$

Bitwise Operators

digits * Decimal
0 - 9

15.8.

Decimal \rightarrow Binary

Binary \rightarrow Decimal

Binary . (2)

digits: 0, 1

$20 \rightarrow$ []
 $5 \rightarrow 101$ []
 $6 \rightarrow 110$ []
Binary

Decimal = 35.

0000 | 00011

$2 | 35$
17
8
4
2
1

1.
1.
0.
0.
0.

int
↓
4 Bytes
↓
32 bits

$$\begin{array}{r}
 + \alpha \\
 1 \\
 \hline
 0
 \end{array}$$

Decimal = 52

110100

$$\begin{array}{r}
 2 | 52 \\
 2 | 26 \quad 0 \\
 13 \\
 2 | 13 \quad 0 \\
 6 \\
 2 | 6 \quad 1 \\
 3 \\
 2 | 3 \quad 0 \\
 1
 \end{array}$$

17:

10001

$$\begin{array}{r}
 2 | 17 \\
 2 | 8 \quad 1 \\
 4 \\
 2 \quad 0 \\
 2 \\
 1 \quad 0
 \end{array}$$

Binary \rightarrow Decimal:

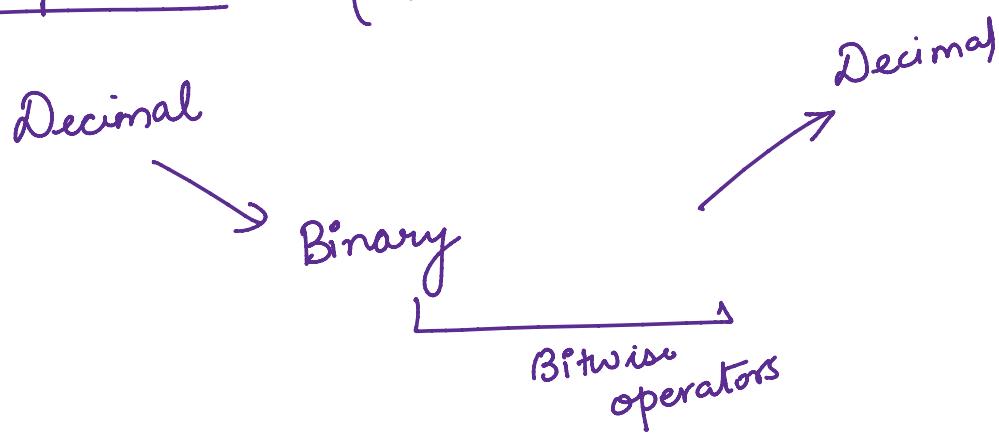
$$\begin{array}{r}
 1011 \\
 2^3 \ 2^2 \ 2^1 \ 2^0
 \end{array}$$

$$\begin{array}{r}
 1 * 2^3 \quad + \frac{0 * 2^2}{2} \quad + \frac{1 * 2^1}{1} \quad + \frac{1 * 2^0}{1} \\
 \sim \qquad \qquad \qquad + \qquad - \qquad \qquad \qquad = \qquad 11
 \end{array}$$

$$1 * 2^5 + 0 * 2^4 + \underline{1 * 2^3} + \underline{1 * 2^0} = \underline{\underline{11}}$$

$$\begin{array}{r} 1010110 \\ 2^6 \quad 2^5 \quad 2^4 \cdot 2^0 \\ 1 * 2^7 + 1 * 2^5 + 1 * 2^3 + 1 * 2^2 + 1 * 2^0 \\ 128 + 32 + 8 + 4 + 1 = 173 \end{array}$$

Bitwise Operators (bits)



① Bitwise AND (4)

Bit 1	Bit 2	O/P
0	0	0
0	1	0
1	0	0
1	1	1

... = 4
... = 1111

$$4 \oplus 4 = 0$$

$$\begin{array}{r} 0111 \\ +100 \\ \hline 0100 \end{array} \rightarrow 0$$

5 & 3

$$\begin{array}{r} 101 \\ 011 \\ \hline 001 \end{array} \rightarrow 1$$

2) Bitwise OR (|)

Bit 1	Bit 2	O/p.
0	0	0
0	1	1
1	0	1
1	1	1

$\neq | 17$

$$\begin{array}{r} 00111 \\ 10001 \\ \hline 10111 \end{array} \rightarrow 23.$$